July 30, 1929. O. C. GRUENDER 1,722,792

SCREEN

Filed Feb. 25, 1927 3 Sheets-Sheet 1

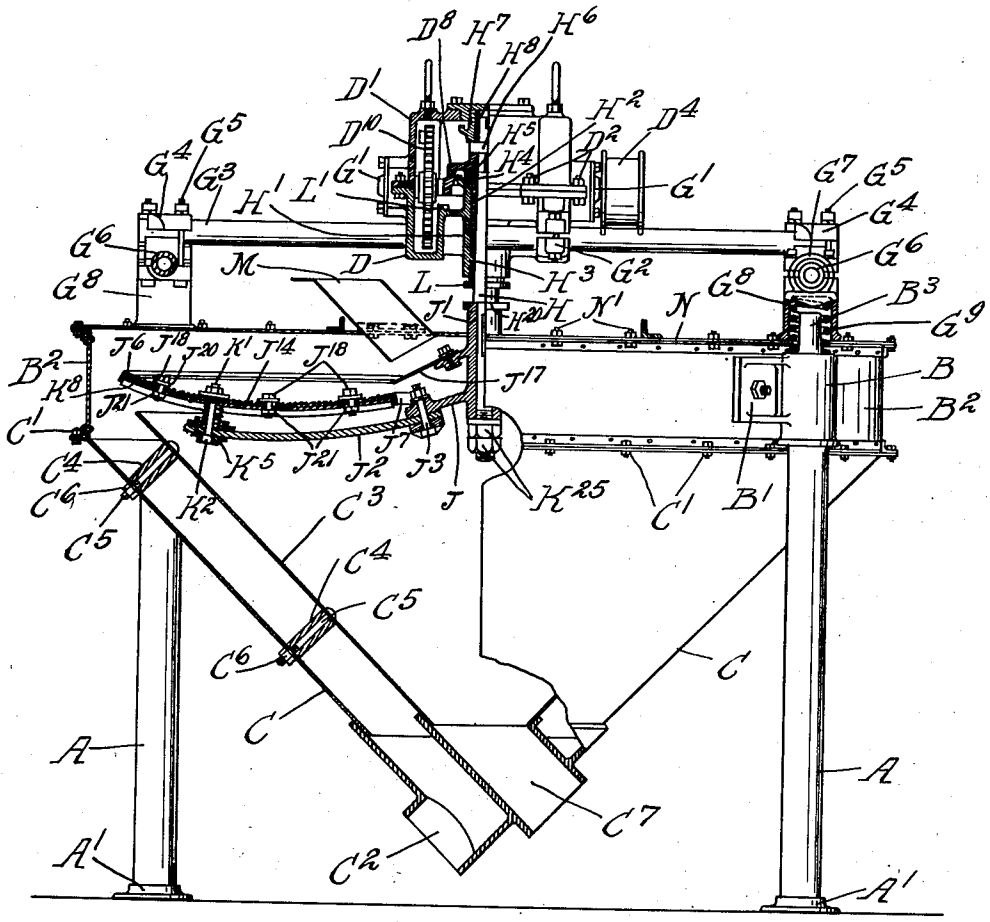


Fig. 1

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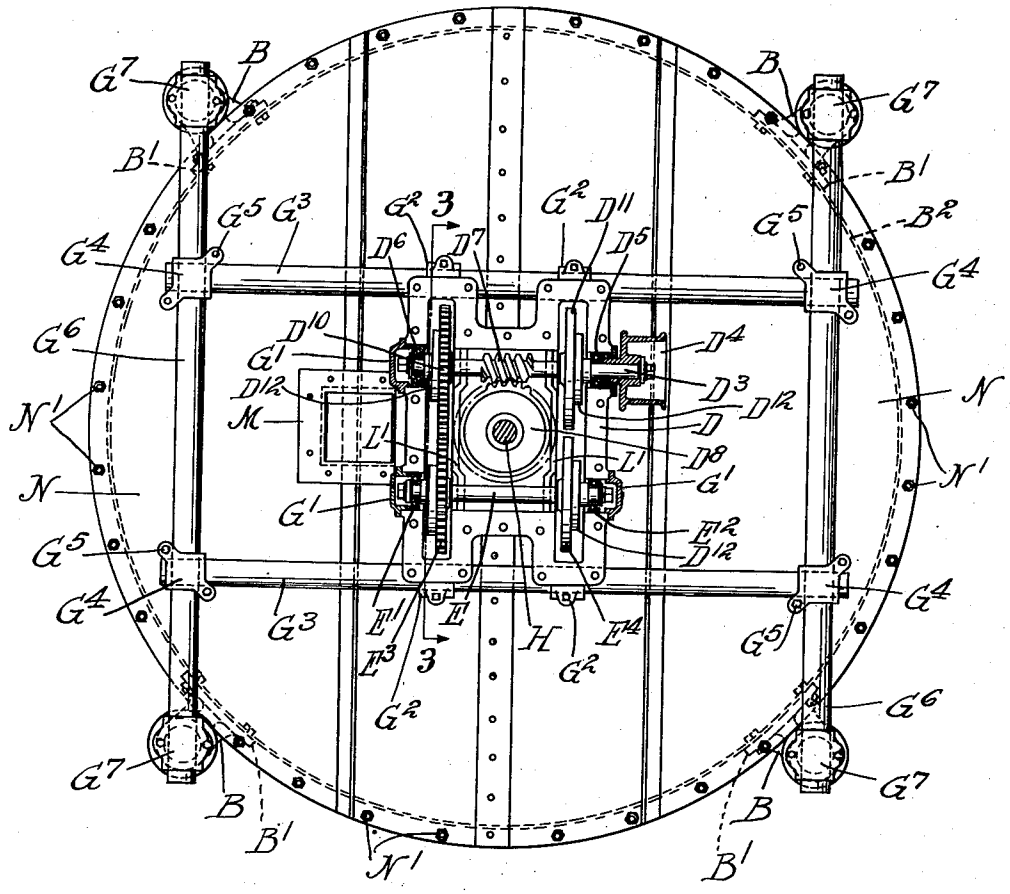


Fig. 2

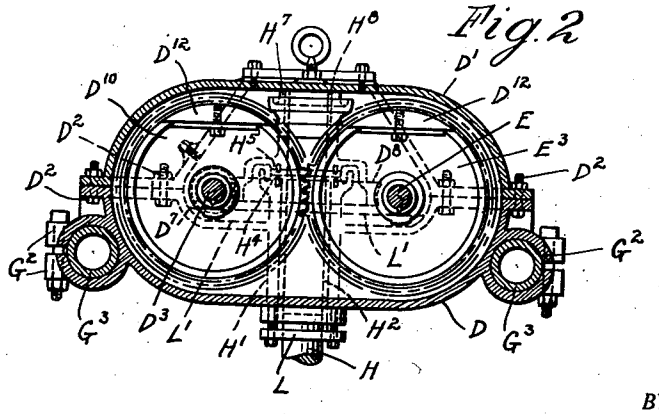


Fig. 3.

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Fig. 4

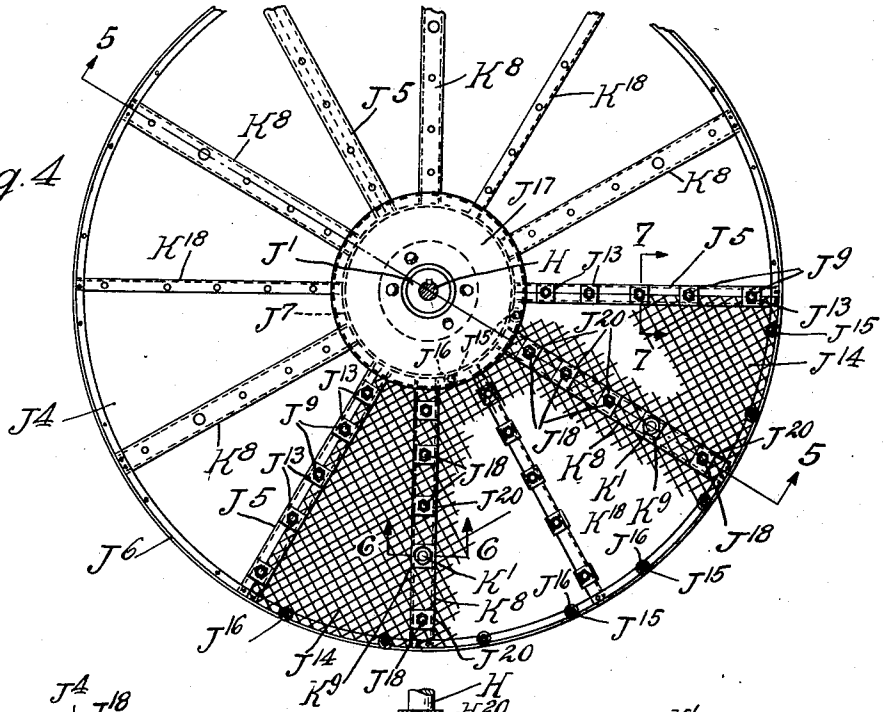


Fig. 5

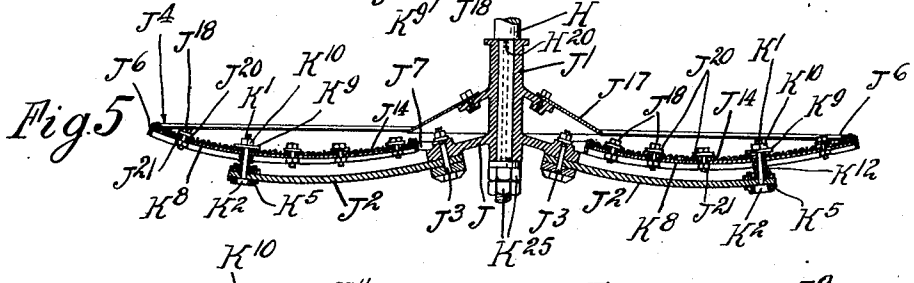


Fig. 6

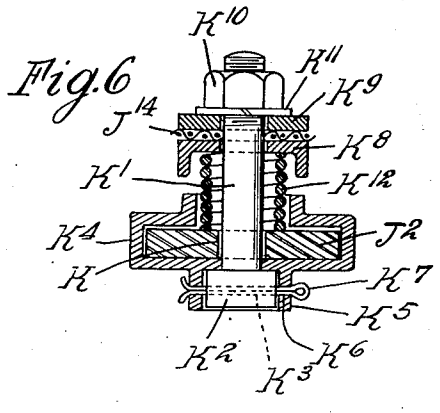
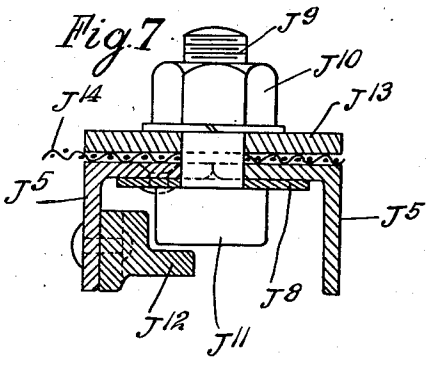


Fig. 7



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UNITED STATES PATENT OFFICE.

OSCAR C. GRUENDER, OF CHICAGO, ILLINOIS.

SCREEN.

Application filed February 25, 1927. Serial No. 170,812.

My invention relates to improvements in screens and relates particularly to a new and improved form of centrifugal vibratory screen. One object is to provide means for simultaneously vibrating and revolving the screening surface through a single application of power. Another object is to provide new and improved means for so vibrating the screen as to confine the vibrations solely to the screening surface and to prevent the vibration of the other elements of the screen. Another object is to the provision of a new and improved construction of yielding support for the screening surface. Other objects will appear from time to time in the course of the specification and claims.

I illustrate my invention more or less diagrammatically in the accompanying drawings, wherein—

Figure 1 is a side elevation of my screen with parts in vertical section;

Figure 2 is a plan view of my screen with the gear box cover removed;

Figure 3 is a vertical section through the gear box on the line 3—3 of Figure 2;

Figure 4 is a plan view of the screening surface;

Figure 5 is a section on the line 5—5 of Figure 4;

Figure 6 is a section on the line 6—6 of Figure 4; and

Figure 7 is a section on the line 7—7 of Figure 4.

Like parts are indicated by like characters throughout the specification and claims.

A—A are pipe supports or legs, four in number, provided at their lower ends with floor flanges or bases A^1.

B—B are supporting brackets, secured at the upper ends of the pipes A and provided with ears B^1 which are bolted or otherwise suitably secured to a circular housing or frame member B^2. B^3 is a cylindrical lug upwardly projecting from the support member B, the purpose of which will later appear.

C indicates an outer conical discharge member bolted or otherwise secured as at C^1 to the lower edge of the frame member B^2. It terminates at the bottom in the spout member C^2. Inwardly spaced from the outer conical discharge member C is the similar member C^3 supported and secured by means of the spacers C^4, the bolts C^5 and the nuts C^6. It terminates in a discharge spout or chute C^7 which projects outwardly through the upper wall of the spout C^2. As shown in Figure 1 the two spout members are indicated as integral but it will be realized that I do not wish to limit myself to any particular construction or association of the two spout members.

D generally indicates a gear box having a cover member D^1 secured to it for example by the bolts D^2. Penetrating the walls of the gear box is the shaft D^3 to the outer end of which is secured any suitable pulley D^4. D^5 D^6 indicate any suitable bearings for the opposite ends of the shaft, herein shown as roller or ball bearings. D^7 is a worm section on the shaft in mesh with the worm wheel D^8, upon the vertical shaft H. Adjacent opposite ends of the shaft D^3 are the unbalanced gear wheel D^{10} and the unbalanced disk D^{11}, having the adjustable counterweight D^{12}.

E is a shaft, parallel with the shaft D^3, mounted in any suitable roller or ball bearings E^1 E^2. The shaft is provided with an unbalanced gear E^3 in mesh with the gear D^{10}, and an unbalanced disc E^4 corresponding to the unbalanced disc D^{11}.

To the gear box D is bolted the gear box cover D^1. It will be understood that the opposed upper edge of the gear box D and lower edge of the gear box cover D^1 are suitably formed to contain and position the bearings for the shafts D^3 and E. G^1 indicate any suitable closures or caps for closing the apertures so formed in the wall of the gear box.

At each end of the gear box D are two hubs G^2 through which pass the cross pipe members G^3. Secured to each end of each such cross pipe member is a clamp member G^4 provided for example with the bolts G^5, whereby the clamping members are secured to the transverse pipe cross-members G^6. At the ends of the members G^6 are secured supporting members G^7 terminating in the generally cylindrical lower extensions G^8 adapted to surround the lugs B^3 on the members B. G^9 indicate supporting springs interposed between the members B and said caps G^8, whereby the entire assembly above described is yieldingly supported upon the members B.

H indicates a vertical shaft to the upper portion of which is secured the worm wheel D^8, above described as being in mesh with the worm D^7 whereby it may be rotated. H^1 indicates a bearing sleeve formed integrally with the gear box D and H^2 is an anti-fric-

tion bearing of any suitable material supported at its lower end by the inwardly projecting lug H^3. H^4 H^5 are opposed thrust bearings, the first mounted on the sleeve H^1 and the second on the bottom of the hub of the worm wheel D^8. H^6 is an outward projection or flange on the shaft H adapted to engage the face of the hub of the worm wheel D^8 and adapted to be engaged by the confining member H^7 downwardly projecting from the gear box cover D^1. H^8 is any suitable antifrictional bearing, contained in the member H^7, for the upper end of the shaft H. It will thus be evident that vertical movement of the shaft H, in relation to the gear box assembly, is rendered impossible.

To the lower end of the vertical shaft H is secured a spider J having the hub J^1. Referring to Figures 1 and 5 it will be seen that the shaft H is provided with a shoulder H^{20}, against which the hub J^1 is drawn up by the nuts K^{25}. Outwardly extending from said spider are a plurality of leaf springs J^2 bolted or otherwise suitably secured as at J^3 to the spider. Supported upon said springs J^2 is a screen frame J^4 herein shown as formed in three sections. Said frame is built in a plurality of segments, herein shown as three. Each such segment includes the radial angle and channel irons J^5, K^8, K^{18}, an outer arcuate angle iron J^6 and an inner arcuate angle iron J^7, the irons J^6 and J^7 being concentric. The three sections or segments are readily assembled and disassembled. The junction between adjacent segments is shown in Figure 7 wherein, to one of the angles J^5 is riveted a radial plate J^8 which is apertured to permit the passage of the securing bolts J^9, which carry the nuts J^{10} and the enlarged square heads J^{11}. J^{12} is a bolt lock member riveted to the same angle J^5 to which the plate J^8 is riveted. It has for purpose to prevent the escape of the bolt and to prevent its turning. J^{13} indicate flat straps superposed upon the mesh J^{14} and adapted to be clamped thereagainst by the nuts J^{10}. When the straps are in place and the nut J^{10} drawn down on the plate J^{13} it will be realized that the entire screen frame is clamped together to act as a unit. It will be understood that the screening mesh J^{14} overlies the members J^6 and J^7 and is secured to them by the bolts J^{15} and washers J^{16}.

The unit so formed is supported upon the flexible spring arms J^2 in the following manner. The ends of the members J^2 are apertured, as at K, to permit the passage of the bolt K^1. The bolt is provided with a square lower end K^2 apertured as at K^3. Surrounding the end of the spring J^2 is a member K^4 provided with a socket portion K^5 adapted to contain the head K^2 of the bolt K^1, and to prevent rotation of the bolt. This is apertured as at K^6 to permit the passage of the cotter pin K^7, which passes off through the aperture K^3 in the squared bolt head. Thus the bolt is held against vertical movement and against rotation. K^8 is a radial channel member secured to J^6 and J^7, upon which the screening mesh J^{14} is supported. K^9 are plates or straps similar to the members J^{13} and are adapted to be drawn down against the member K^8 and the screening mesh J^{14} by the nuts K^{10} and washers K^{11}.

Interposed between the top of the spring J^2 and the bottom of the channel K^8 is a coil spring K^{12} which is tightly wound and has for purpose to provide a flexible or universal connection between the spring arms J^2 and the screen assembly. It will be understood that whereas the nut K^{10} is drawn down so tightly as to hold the screen normally in fixed relation with the spring arm J^2, nevertheless there is sufficient flexibility of support to permit the bolt K^1 to tilt and to give the effect, within a restricted arc of movement, of a universal connection. This is vital, since any binding of the parts at this point will affect the movement of the screen and will result in a rapid breakage of the engaging or connecting members. It will be realized that the six bolts K^1 are the sole securing means employed to support the screen frame upon the leaf springs J^2.

J^{17} is any suitable deflector plate mounted upon the hub J^1 of the spider. The screening mesh J^{14} is secured to the channel K^8 by means of bolts J^{18} penetrating a strap J^{20} similar to the member J^{13} and held rigid by a nut J^{21}.

N is a cover plate bolted or otherwise secured as at N^1 to the circular housing B^2.

It will be realized that whereas I have described and shown a practical and operative device, nevertheless many changes might be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a sense broadly diagrammatic and illustrative rather than as limiting me to my specific showing.

The use and operation of my invention are as follows:

Power is applied through the pulley D^4 keyed to the worm shaft D^3. Since the unbalanced gears D^{10} and E^3 have the same number of teeth, the shafts D^3 and E rotate at like speed but in opposite directions. The counterweights on said gears and on the accompanying discs are so placed that all lateral vibration is eliminated, vibration being limited to a vertical axis. The vertical shaft H is driven through the worm D^7 and the worm wheel D^8, whereby the screening assembly is rotated. The shafts D^3 and E are rotated at the high rate of speed necessary to effect the desired rate of vertical vibration, but the vertical shaft H, on account of the large reduction produced by worm and worm

wheel revolves at a comparatively low rate of speed. Obviously although I illustrate a drive through the pulley D^4 I may dispense with the intermediate power transmission and secure driving means direct to the worm shaft D^3.

The gear box is provided with a stuffing box gland L, whereby leakage of oil is prevented. In assembling the device the gear box is filled with oil to a suitable level, and oil is picked up and thrown by the gears and discs against the gear box cover. The oil flowing down on the inside of the gear box automatically lubricates all bearings and the oil tight gear box prevents any oil leakage. The raised ribs L^1 on the inside of the gear box maintain such a level of oil that the worm D^7 continually runs in oil.

The material to be screened is fed through the feed spout M and upon the deflector plate J^{17}. It is thrown therefrom and is centrifugally fed across the screening surface. During operation the rapid rotation of the unbalanced gears and discs causes a vertical vibration which is transmitted to the flexible leaf springs J^2.

In practical use, and owing particularly to the flexible connection between the ends of the springs J^2 and the screen assembly, the vertical vibration of the screen is uniform from inner to outer edge. The flexible connection has the further advantage of preventing any clamping or binding of the parts which would otherwise result from the flexing of the springs J^2.

When the rotation first begins the gear box and attached parts are thereby caused to vibrate on the four coil springs G^9. As soon as the screen is up to speed, the gear box ceases perceptible vibration, and effective vibration is limited to the screening surface. In other words, an initial vibration is set up first in the gear box and attached parts, but as soon as the screen is rotating at full speed, a secondary vibration is set up in the screen frame, supported as it is on the long leaf springs J^2. The secondary vibration tends to neutralize the initial vibration of the gear box and gear box assembly, and when the device is operating the gear box floats perceptibly but slightly on the four coil springs G^9, but does not have sufficient vibration to cause any perceptible vibration of the supporting frame.

This transmission of vibration to the screen and the limitation of vibration to the screen assembly is explained by the fact that in my screen I have two masses or members, yieldingly supported and connected to permit independent vibration. The heavier mass, namely the gear box and its supporting parts, begins to vibrate first and the second mass, namely the screen frame supported on the springs J^2, takes up a secondary imparted vibration. The difference in the weights of the gear box and the spring frame and the synchronizing of the vibration causes a substantially complete transmission to the screen frame of the vibration created by the rotation of the unbalanced gears and discs. The result is the substantially complete cessation of any apparent vibration on the part of the gear box and its supporting members, and a very rapid vibration of the screening surface mounted on the flat spring bars.

I find that in order to produce this compensation of the vibration it is necessary to rotate the unbalanced members within a certain range of speed. Rotation of from 800 to 900 R. P. M. produces the best result in the particular mechanism I have employed and a speed as high as 1200 R. P. M. or over tends to break down the synchronization of the vibration and to cause the gear box and attached parts to vibrate. It will be realized of course that I do not wish to be limited to any particular rate or range of vibration, since it may vary with different sizes and designs of screen.

I claim:

1. In a centrifugal screen, a supporting structure, a screen member, a vertical shaft yieldingly supported on said supporting structure and means for rotating it and for imparting vertical vibration thereto, and a yielding connection between said shaft and said screen member.

2. In a centrifugal screen, a supporting structure, a screen member, a vertical shaft yieldingly supported on said supporting structure and means for rotating it and for imparting vertical vibration thereto, and a yielding connection between said shaft and said screen member, including a plurality of radial spring members projecting laterally from said shaft.

3. In a centrifugal screen, a supporting structure, a screen member, a vertical shaft yieldingly supported on said supporting structure and means for rotating it and for imparting vertical vibration thereto, and a yielding connection between said shaft and and said screen member, including a plurality of radial supporting members, and flexible supporting members interposed between said supporting members and the screen member.

4. In a centrifugal screen, a supporting structure, a screen member, a vertical shaft yieldingly mounted on said supporting structure and means for rotating it and for imparting vertical vibration thereto, and a yielding connection between said shaft and said screen member, including a plurality of radial spring members projecting laterally from said shaft, and flexible supporting members interposed between said radial spring members and the screen member.

5. In a centrifugal screen, a vertical screen shaft, means for rotating it, and means for imparting to it vertical vibration, a plurality

of radial arms extending from said shaft and a screen member flexibly mounted at the extremities of said radial arms.

6. In a centrifugal screen, a vertical screen shaft, means for rotating it, and means for imparting vertical vibration to it, a plurality of radial arms extending from said shaft, a screen member mounted at the extremities of said radial arms and flexible supporting members interposed between the ends of said arms and the screen member, said members including closely wound coils.

7. In a centrifugal screen, a vertical screen shaft, means for rotating it, and means for imparting vertical vibration to it, a plurality of radial arms extending from said shaft, a screen member mounted at the extremities of said radial arms and flexible supporting members interposed between the ends of said arms and the screen member, said members including closely wound coils, and means for drawing said screen member and arms together about said coils.

8. In a centrifugal screen, a vertical screen shaft, means for rotating it, and means for imparting vertical vibration to it, a plurality of radial arms extending from said shaft, a screen member mounted at the extremities of said radial arms and flexible supporting members interposed between the ends of said arms and the screen member, said members including bolts passing through the arms and the screen members, and flexible spacing members surrounding said bolts.

9. In a centrifugal screen, a vertical screen shaft, means for rotating it, and means for imparting vertical vibration to it, a plurality of radial arms extending from said shaft, a screen member mounted at the extremities of said radial arms and flexible supporting members interposed between the ends of said arms and the screen member, said members including bolts passing through the arms and the screen members, and flexible spacing members surrounding said bolts, and means for preventing rotation of said bolts including members mounted upon said arms and engaging the heads of said bolts.

10. In a centrifugal screen, a vertical screen shaft, means for rotating it, and means for imparting vertical vibration to it, a plurality of radial arms extending from said shaft, a screen member positioned above said radial arms, and flexible spacing members interposed between said arms and the screen member.

11. In a centrifugal screen, a supporting structure, a screen member, a vibrating unit yieldingly supported on said supporting structure, a screen shaft extending therefrom, and a yielding supporting connection between the shaft and the screen member.

12. In a centrifugal screen, a supporting structure, a screen member, a vibrating unit yieldingly supported on said supporting structure, a screen shaft extending therefrom, and a yielding supporting connection between the shaft and the screen member, the vibrating unit including a drive shaft, a driven shaft, meshing unbalanced gears on drive and driven shafts, and a driving connection between one of said shafts and the screen shaft.

13. In a centrifugal screen, a supporting structure, a screen member, a vibrating unit yieldingly supported on said supporting structrue, a screen shaft extending therefrom and a yielding supporting connection between the shaft and the screen member, the vibrating unit including a drive shaft, a driven shaft, meshing unbalanced gears on drive and driven shafts, additional unbalanced elements upon said shafts, and a driving connection between one of said shafts and the screen shaft.

14. In a vibrating unit for a centrifugal screen, a gear box, a pair of parallel shafts positioned in said gear box to rotate about horizontal axes, and means for applying motive force to one of them, meshing unbalanced gears on said shafts, a screen shaft extending into said gear box and a driving connection between such screen shaft and one of said horizontal shafts.

15. In a vibrating unit for a centrifugal screen, a gear box, a pair of parallel shafts positioned in said gear box to rotate about horizontal axes, and means for applying motive force to one of them, meshing unbalanced gears on said shafts, a screen shaft extending into said gear box, a worm on one of said shafts and a worm gear on said screen shaft, in mesh therewith.

16. In a vibrating unit for a centrifugal screen, a gear box, a pair of parallel shafts positioned in said gear box to rotate about horizontal axes, and means for applying motive force to one of them, meshing unbalanced gears on said shafts, a screen shaft extending into said gear box and a driving connection between such screen shaft and one of said horizontal shafts, and additional unbalanced members upon said horizontal shafts, said members and gears of each such shaft being positioned at opposite ends thereof.

17. A screen member for centrifugal screens including a plurality of separate and detachable frame members, each such frame having inner and outer arcuate frame members and radial connecting frame members, and means for securing together the abutting radial frame members of adjoining screen sections, including plate members secured to one of each pair of abutting radial frame members, securing members passing therethrough and clamping members adapted to be drawn by said securing members downwardly against the screen.

18. A screen member for centrifugal

screens including a plurality of separate and detachable frame members, each such frame having inner and outer arcuate frame members and radial connecting frame members, and means for securing together the abutting radial frame members of adjoining screen sections, including bolt members secured to one of each pair of abutting radial frame members, securing bolts passing therethrough, clamp nuts on said bolts, adapted to be drawn downwardly against the screen and means, associated with the radial frame members, for preventing rotation of said bolts.

19. In a centrifugal screen, a supporting structure, a screen member, a vibrating unit yieldingly supported on said supporting structure, a shaft extending therefrom, the screen member being yieldingly supported thereupon, means for imparting an initial vibration to the vibrating unit, means for imparting a secondary vibration to the screen member, and for thereby neutralizing the initial vibration and preventing any substantial vibration of the vibrating unit during normal vibration of the screen member.

20. In a centrifugal screen, a supporting structure, a vibrating unit yieldingly supported thereon, a screen member in yielding relation with said vibrating unit and adapted to be vibrated thereby, means for imparting an initial vibration to the vibrating unit and means for transmitting a secondary vibration to the screen member and neutralizing the initial vibration of the vibrating unit.

21. In a centrifugal screen, a supporting structure, a vibrating unit yieldingly supported thereon, a screen member yieldingly supported from said vibrating unit and adapted to be vibrated thereby and means for actuating the vibrating unit and for imparting to the screen member a vibration neutralizing the vibration of the vibrating unit itself.

22. In a centrifugal screen, a supporting structure, a screen, a vibration imparting unit yieldingly supported on said supporting structure, a shaft extending therefrom, the screen being flexibly supported upon said shaft, means for actuating the vibration imparting unit and thereby imparting vertical vibration to said shaft and screen, and means for rotating said shaft and screen, the screen and its supporting connection, being adapted substantially to neutralize the vibration of the vibration imparting unit itself, during normal vibration of the screen.

Signed at Chicago, county of Cook, and State of Illinois, this 23rd day of February, 1927.

OSCAR C. GRUENDER.